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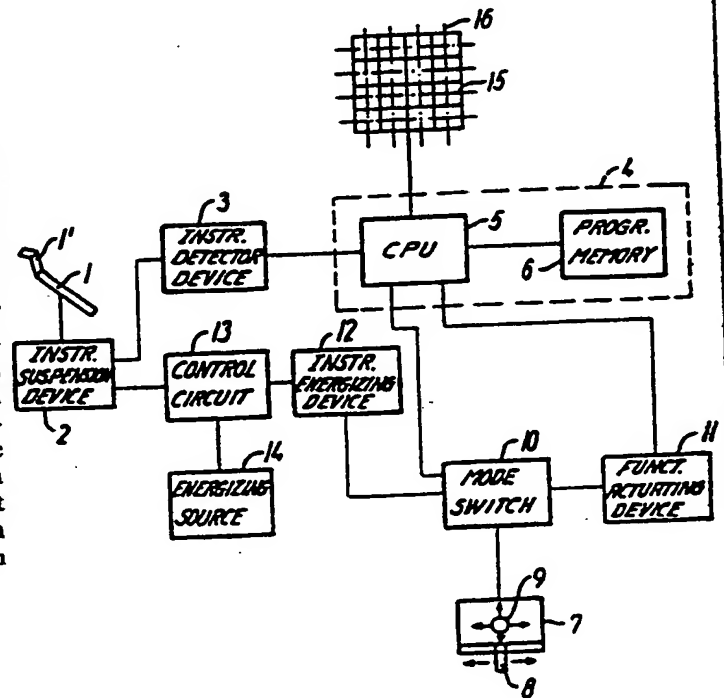
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: A MICROPROCESSOR-CONTROLLED DENTAL APPARATUS

(57) Abstract

A dental apparatus comprises a number of dynamic dental instruments, an instrument selector device for selecting an instrument from the instrument carrier (1), a foot contact (7) with a movable control member (8) for activating and controlling a selected instrument and for activating possible auxiliary functions in conjunction with the operation of said instrument, and a microprocessor (4) for monitoring and controlling the operational functions of the instrument and said auxiliary functions. The microprocessor (4) is connected to a monitoring and control display (15) with a number of function display fields for visually displaying instrument operation functions and auxiliary functions, partial functions or functional sequences, and a selection switch is associated with each function display field for the selection of a function displayed in the field. The operational functions of the instrument and the programming functions are arranged in a hierarchically organized menu system including for each set of displayed operation functions an instrument menu at a first level and at least one adjustment menu associated with the instrument menu located at a sub-ordinated level.



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A microprocessor-controlled dental apparatus.

The invention relates to a dental apparatus comprising an instrument arrangement having a number of carriers for dynamic dental instruments, energizing units associated therewith, a detector device responsive to the removal of an instrument from its carrier, an instrument operator device including a foot contact with a movable control member for activating and controlling a selected instrument and for the control of auxiliary functions in conjunction with the operation thereof, and a microprocessor for monitoring and controlling the operational functions of the instruments and their auxiliary functions.

EP-patents Nos 42,268 and 42,269 disclose such dental apparatuses providing for obtaining a very extensive simplification and automatization of the dentist's performance of a number of different operational functions during a dental treatment, a single foot contact being used for the general operation of an instrument taken from the instrument carrier and for effecting various auxiliary functions in this respect, such as activating the air blow and spray pre-selection of the coolant applied when using a motor or turbine driven instrument, the control member of said foot contact being moved in various directions and, on the other hand, actuated either to a very short duration of the movement or to a longer duration of the movement.

In connection with a particular mode switch-over the foot contact may further, provided all instruments occupy their home positions in the instrument carrier, be used for activating a number of auxiliary functions not associated with the operation of the instruments, e.g. adjustment of the patient's chair, activating the fountain flush, filling water in the rinsing glass and call the dentist's assistant.

Starting from said prior dental apparatus it is an object of the invention to further develop the efforts with respect to simplification and automatization so that the foot contact may be used to control so
5 to say any imaginably occurring operations and auxiliary functions and to provide at the same time a monitoring and control system allowing the dentist at any time to get access to information about the actual status of the dental apparatus with a view to opera-
10 tional parameters of instruments etc., and further offering a considerable increase of optional possibilities of individual adjustment of operational parameters and auxiliary functions according to the dentist's desire.

15 It is a further object of the invention to provide a dental apparatus which in comparison with prior apparatus designs offers a considerably enhanced information level and a correspondingly improved operational security.

20 This is achieved according to the invention in that a monitoring and control display is associated with the microprocessor and includes a number of function display fields for visually displaying operational functions of the instrument and auxiliary functions,
25 partial functions or functional sequences and selection switches selectively associated with the function display fields for the selection of function displayed in the fields, whereby the total number of selectable functions, partial functions and functional sequences
30 is organized in logically composed sets of function, each comprising a number of functions, partial functions or functional sequences dependent on the number of display fields, and in that the microprocessor on selective activation is adapted to switch between said
35 sets of functions.

The dental apparatus according to the invention is primarily based on the idea of allowing a very con-

siderable number of functions, partial functions and/or functional sequences to be effected by means of a limited number of operational switches, modern information technology being applied to change the functional definition of said switches.

In a very simple embodiment in which the foot contact is solely to be used to operate the instrument and to activate auxiliary functions directly associated therewith, there may thus, for each selected instrument, be provided one or more sets of functions or partial functions corresponding to the number of function display fields. For example, in case of a rotating instrument such sets of functions may comprise a function set offering selection of different velocities, a function set offering choice between various coolant compositions and a special auxiliary set of functions, during the individual functions of which an auxiliary function may be activated by a movement of the control member on the foot contact that is different from the operating movement of the instrument.

According to a second embodiment the monitoring and control display includes at least one separate information displaying field for the display of information concerning the functions displayed in the function display fields. For example, in connection with the selection of an instrument such information may include display of the latest adjusted operational parameters of the actual instrument.

In connection with such an information displaying field on the monitoring and control display an alphanumeric keyboard may be connected to the microprocessor, thereby adapting at least one information displaying field to display information keyed by means of the keyboard. Such information generated by the keyboard may for instance include identifying information concerning the actual patient.

The monitoring and control display may in that respect particularly be constituted by an image screen with associated control devices and be adapted to display text and video information, said screen including the function display fields in a predetermined area. This provides for using the same screen for instance to display data base information concerning the dental status of the patient and to display X-ray pictures and instruction programs reproduced from video tapes.

10 In a further preferred embodiment a mode switch which, in dependence on information from the instrument selector device, is controlled by the microprocessor known per se from the above mentioned EP-references, is adapted in a first mode of operation, in which all
15 instruments occupy their home positions in the instrument carrier, to switch on the foot contact to activate auxiliary functions not associated with the instrument operation. According to the invention the microprocessor may in this embodiment in a first mode of operation
20 tion be adapted to display auxiliary functions not associated with the instrument operation in the function display fields of the monitoring and control display and, in a second mode of operation, in which an instrument is selected for use, be adapted to display
25 operational parameters of said instrument and, when selecting one of said functions by means of the function selection switches, to switch on the foot contact to actuate an activation device for the actual auxiliary function.

30 According to a further aspect of the invention it is preferred that the function display fields and the selection switches selectively associated with the fields are organized in a matrix arrangement, that the instrument operating functions and programming functions
35 tions are organized in a hierarchically structured menu system which, for each set of operating functions

displayed on the display, comprises an instrument menu located at a first (N) level and which is displayed on the monitoring and control display when selecting the actual instrument, thereby displaying in the function display fields of the display actually adjusted operational parameters of the operation of said instrument and/or of auxiliary functions associated with the instrument, and at least one adjustment menu associated with the instrument menu and located at a subordinate level, and on the display of the instrument menu as well as the adjustment menu on the display in one of its fields a level shift function is displayed, for switching over the display to show an adjustment menu and switching it back to display the instrument menu, respectively, by operating the selection switch communicating with the field.

With respect to multi-user systems, this provides for achieving an advantageous increase of the number of selectable operating functions for the individual instruments, opening up the possibility of a fully implemented user-individual programming of said functions, thereby making it possible inter alia to adjust operational parameters and associated auxiliary functions, also when the instrument has been removed from its carrier.

By actuating the foot contact for the operation of an instrument one or more sets of functions may be provided for a selected instrument, each set offering a number of functions corresponding to the number of function display fields, for instance for a rotating instrument one set of functions allowing choice between different velocity functions and one set of functions allowing choice between different coolant compositions.

In connection with a mode switch-over, by which the foot contact may be used, when all instruments are in their home positions, to activate auxiliary func-

tions not associated with the instrument operation, such auxiliary functions may as well be displayed in the fields of the monitoring and control display and selected by means of associated selection switches. The
5 auxiliary functions may comprise one or more programming function(s) by means of which a possible user-individual programming may be effected to adjust operational parameters and/or auxiliary functions.

In a simple design such a dental apparatus
10 according to the invention may include a number of instrument menus for individual dynamic instruments and one or more adjustment menu(s) for each instrument menu.

A considerably more flexible utilization of the
15 range of instruments used for the dental apparatus is, moreover, obtained according to a preferred embodiment in that the instrument carriers are associated with instrument suspension devices for optional coupling of various dynamic instruments, that each suspension
20 device includes an instrument sensor member for sensing the type of the actually connected instrument, and in that an energizing source common to the instrument carriers is connected to a control circuit controlled by the microprocessor for adjusting said energizing
25 source to an energy generating function adapted to the selected instrument.

With a design of the dental apparatus with a mode switch of the above type the hierarchically organized menu system may include a main menu at a superior
30 level, on the display of which on the display, identification information about a number of auxiliary functions not associated with the instrument operation is shown in a number of its fields, and on the display of each instrument menu on the display, a level shift
35 function for switch-back to the overlying level is shown in one of the display fields.

With an instrument removed from its carrier, it will thus be possible to switch back to the main menu and activate one the auxiliary functions related thereto, also when using the instrument.

5 The invention will now be explained in further detail with reference to the schematical drawings, in which

Fig. 1 in a block diagram illustrates the parts of a preferred embodiment of the dental apparatus according to the invention, necessary to understand the invention,

Fig 2 is a first embodiment of a monitoring and control panel,

15 Fig. 3 is a synoptic illustration of a hierarchically organized system of menus for operation and auxiliary functions of the dental apparatus, and

Figs 4 to 6 are examples of a main menu, an instrument menu and an adjustment menu, respectively, 20 in the menu system.

In Fig. 1 numeral 1 designates a dynamic dental instrument accommodating as energizing unit a microprocessor mounted in the handle of the instrument. Different coupling members 1' may be connected to the 25 instrument to receive drills, polishing pads etc. by means of a snap coupling, said coupling members usually including transmission devices of varying gearing ratios.

Each dynamic instrument 1 is accommodated in 30 and communicates with an instrument suspension device 2 which according to a particular feature of the invention may be designed for optional coupling of different instruments and may in this respect include a sensor member for sensing the type of the actually connected instrument. In this context typical instruments 35 include an electric micromotor, a turbine driven by

pressurized air, an electric composite hardening lamp and an ultrasound dental cleaning device.

The instrument suspension device 2 is connected through an instrument detecting device 3 to a micro-processor 4 containing a CPU unit 5 and a program memory 6, by which the operation functions of the instruments of the dental apparatus as well as a series of auxiliary functions are monitored and controlled.

When instrument 1 is selected for use by taking it out of its home position on the instrument table, a signal is emitted from the detecting device 3 to the microprocessor 4, following which the activation and controlling of the operation of the instrument is effected by a foot contact 7 having a control member 8 movable in both lateral directions from a neutral central position. In the illustrated embodiment the foot contact 7 includes a further switch member 9, for instance designed as a so-called "joy stick" with four switching positions and the function of which will be explained in the following.

By means of a mode switch 10 controlled by the microprocessor 4 in dependence on the signals from the detector device 3 the foot contact may be used, in a first mode of operation, in which all instruments occupy their respective home positions, to activate and perform a number of auxiliary functions not associated with the instrument operation, the foot contact 7 being coupled via the mode switch 10 to a function activating device 11 activating said auxiliary functions either by various movements of the control member 8 on the foot contact 7 or by means of the monitoring and control display to be explained in the following.

In a second mode of operation in which an instrument 1 is selected for use, the foot contact 7 is connected to an instrument energizing device 12

and thereby to a control circuit 13 monitored by the microprocessor 4, said circuit taking care, inter alia by selection of a suitable energizing source 14, to adapt the supplied electric energy to the actual dynamic dental instrument.

The above mentioned parts of the dental apparatus operate mainly in the same manner as explained in EP patents Nos 42,268 and 42,269. In addition to the virtual operation of the instruments, foot contact 7 may also be used to activate a number of auxiliary functions not associated with the operation of the instruments.

As mentioned in the latter EP patent, the foot contact 7 may be utilized, during the operation of the instrument, to activate auxiliary functions associated directly with the operation of a selected instrument, such as varying the air-water composition of a coolant applied during use of the instrument, by actuating the control member 8 to a movement different from the instrument operation movement, with respect to direction or duration.

A monitoring and control display 15 is connected to the microprocessor 4.

A first embodiment such a monitoring and control display is schematically illustrated in Fig. 2.

In this example the monitoring and control display 15 includes, on one hand, three information displaying fields 210, 211 and 212 and, on the other hand, four function display fields 213, 214, 215 and 216 for visually displaying instrument operation functions and auxiliary functions, sub-functions thereof or functional sequences. A selection switch for the selection of the function displayed in the field is associated with each of the function display fields 213, 214, 215 and 216. In the illustrated example said selection switches are implemented by means of IR- or

UV-rays 217, 218, 219 and 220 each passing a respective one of the function display fields from a radiation source 217a to 220a to a radiation detector 217b to 220b. The illustrated positioning of the function display fields 213 to 216 in alignment on a single row on the display, thus allows the selection switches 217 to 220 to be selectively activated by placing a finger in an activation zone opposite the actual function display field.

However, the invention is not restricted to the implementation of the monitoring and control display 15 illustrated in Fig. 2. The information display fields 210, 211 and 212 may for instance be left out and the display 15 may as illustrated in Figs 4 to 6 include a larger number of function display fields in a matrix-arrangement of rows and columns with an associated arrangement of selection switches obtained by means of IR- or UV-rays in directions perpendicular to each other and with intersecting points opposite each respective function display field.

As clearly apparent from Figs 4 to 6, the display 15 in the embodiment illustrated in Fig. 1 is provided with a substantially square display screen divided into 4 x 4 fields to display different functions in connection with the instrument operation. A selection switch arrangement is associated with said function display fields with a selection switch associated with each respective field. An arrangement of touch-free switches is particularly fitted for that purpose and is constituted by the intersecting points between intersecting IR- or UV-rays as schematically shown in dot-and-dash lines 16.

The selection switches associated with individual fields may thus activate a function displayed in the actual field, in that the dentist places his finger on the actual intersecting point in the radiation

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adjustment menus 107 and 108 with the instrument menu 103 and the adjustment menu 109 with the instrument menu 104.

5 In view of the fact that all of the menus illustrated in the diagram may be displayed on the display 15 by activating the selection switch arrangement associated with the display it is an essential aspect of the invention that a level shift function is shown on the panel 15 in one of its fields when displaying
10 an instrument menu as well as when displaying an instrument menu, thereby providing for switching the display from displaying an instrument menu to showing an adjustment menu and back again by means of the selection switch associated with the actual field.

15 To the extent various co-ordinated menus are included in one of levels I, II and III of the hierarchically organized menu system a menu shift function for shifting to a parallel menu will further be shown on the display 15 in one of its fields when
20 displaying each of the parallel menus.

While examples of the implementation of function displays in the fields on the display 15 for selected menus at each of the levels I, II and III will be described in the following with reference to Figs 4 to 6,
25 the diagram in Fig. 2 illustrates for each menu only functional indications in the fields on the display in which the above mentioned level shift functions and menu shift functions are displayed.

The basis of the hierarchically organized menu
30 system and the above mentioned design of the display with 4 x 4 fields in a matrix of columns and rows is particularly to be found in the recognition that the picture on the display 15 in order to obtain a good operational security ought to be clear, while relevant
35 related functions must be displayed on the panel simultaneously.

matrix, pointing in fact at the actual field without touching the screen.

It should be observed that the invention particularly aims at the monitoring and control of many different working programs for the instrument operation
5 irrespective of the fact whether, with all instruments in their home position, a number of auxiliary functions are to be effected as well.

According to the invention an instrument menu
10 forming part of a hierarchically organized system is associated with each set of instrument operation functions. For the embodiment of the dental apparatus illustrated in Fig. 1, a preferred implementation of said hierarchic menu system is illustrated by a diagram
15 in Fig. 3.

The illustrated menu system includes three levels I, II and III, of which the first level I includes a main menu 101 displayed on the display 15 in the mode of operation in which all instruments are
20 in their home position.

Level II of the illustrated diagram includes three parallel instrument menus 102, 103 and 104 associated with one and the same instrument, for instance the instrument 1 with an electric
25 micro-motor. For each of the instruments there is at least one independent instrument menu, but there need not necessarily be several parallel menus, since the necessity thereof depends solely on the number of different working programs or functions to be carried out
30 by the selected instrument.

According to the invention an adjustment menu positioned at the sub-ordinated level III is associated with each instrument menu at level II, as illustrated in the diagram in respect of the menus 105 to 109,
35 of which the parallel adjustment menus 105 and 106 are associated with the instrument menu 102, the

In the illustrated matrix design having 4 x 4 fields, the individual function display fields on the panel 15 are designated a, b, c, d, e, f, g, h, i, k, l, m, n, o, p, q, r, a symbol with a downwards directed
5 arrow is displayed in the diagram in field a of the main menu 101 to indicate switch-over to an instrument menu at the underlying level II from which switch-back to the main menu has been effected. Field d of the same menu displays a symbol in the form of a laterally
10 oriented arrow, indicating switch-over to a parallel main menu 110 at level I.

For each of the instrument menus 102 an upwards directed arrow indicating level shift to the overlying level I and a laterally directed arrow indicating shift to a parallel instrument menu at level II,
15 respectively, are displayed in fields a and d, respectively.

Moreover, for the menus 102 to 104 field b displays a function for switch-over to an adjustment
20 menu at the underlying level III associated with the actual instrument menu. To indicate this function the illustrated design of the picture makes use of a stylized adjustment screw.

For each of the adjustment menus 105 to 109
25 the fields a and d correspondingly show an upwards directed arrow indicating switch-back to the instrument menu at the overlying level II and lateral shift to a parallel adjustment menu at level III.

The mode switch-over not mandatory for the
30 invention is represented in the diagram by a vertically dashed line 111 separating the menus displayed on display 15 in mode A of the apparatus, in which all instruments are in their home positions, from the menus related to the instrument operation in mode B, in
35 which an instrument is removed for use.

The illustrated implementation of the menu system further includes in mode A sub-ordinated menus

at levels II and III. As it will appear from the following, such sub-ordinated menus may be used in the mode wherein all instruments occupy their home position, to activate and control auxiliary functions comprising a large number of adjusting possibilities. Thus, the menus 112 and 113 at level II may for instance be used for regulating the setting of the patient's chair used in connection with the dental apparatus, while the menus 114 and 115 at level III may be used for adjusting operational parameters associated therewith.

In the example of the design of the main menu 101 illustrated in Fig. 4 the display 15 includes besides the function display fields a to r arranged in a 4 x 4 matrix, a comparatively narrow text information field at the top extending throughout the width of the image screen and used to display text information in connection with certain working programs and functions. Each of the function display fields a to r displays graphic symbols for the functions associated with the fields. In view of the fact that the main menu is displayed on the display 15 in mode A, in which all instruments are in their home position, the main menu contains mainly auxiliary functions not associated with the instrument operation proper. As examples of such auxiliary functions the implementation illustrated in Fig. 4 includes the following:

- a - Level shift to an instrument menu at the underlying level II; as described in the following this function allows switch-back to a selected instrument menu at level II from which a shift to the main menu at the overlying level I has been effected with the instrument actually removed for use.
- b - Adjustment menu.

15

- c - Questing menu, displaying on the display a relevant auxiliary text or instruction.
- d - Switching to a parallel menu at level I.
- e - User menu to be used in a multi-user system and
5 allowing any dentist to program individually the operational functions of the instrument.
- f - Communication allowing exchange of brief information between the dentist's working place and other rooms in the dental clinic, e.g. receptionist's room, the sterilization room and
10 opening the doors.
- g - Stop watch with associated alarm function for use in respect of various treatment operations, e.g. hardening period for composite
15 treatments.
- h - Turning-on the X-ray viewer, for instance with automatic turning-off after a certain period of time.
- i - Filling water in the rinsing glass.
- 20 k - Activating the fountain flush.
- l - Turning-on the operation light.
- m - Level shift to the particular chair setting menu 111 which may be used in mode A.
- n,o - These last lowest fields on the display may be
25 p,r - used during the main menu proper to display actually selected working programs for the dental instruments, but by the selection of certain of the above functions, e.g. the multi-user function, the communication function and
30 the stop watch function, these fields may be used to display the available actual selection possibilities; with respect to the multi-user function these fields may thus display identification information of the individual user,
35 thereby allowing the individual user to get access to the working programs selected by him-

16

self just by keying his own code, which may have been set once for all.

By the implementation of the main menu described above by way of example, auxiliary functions not associated with the instrument operation and displayed on the display 15 during the main menu, may be actuated directly by operating the selection switches of the display, thereby making it superfluous in this respect to make use of the foot contact.

As an example of an instrument menu, Fig. 5 illustrates a primary menu for an instrument having an electric micro-motor. In the uppermost row the content of fields b, c and d is unchanged in relation to the main menu, while field a displays the level shift to the main menu at the higher level I. It is then possible, with an instrument removed for use, to switch back to the main menu, for instance in order to carry out an auxiliary function not associated with the operation of the instrument, following which switch-back to the same instrument menu may be effected by means of the level shift function in field a below the instrument menu. The two succeeding rows have been combined into a single row with fields e, f, g and h, which in the actual example is used during the instrument menu to display actually adjusted operational parameters and the coupling member that ought to be used in connection with said adjusted parameters. In view of the fact that the instrument menu may include various individual working programs, the content of said fields vary in dependence on the selected working program. By selecting the working program "CLEAN" the fields e to h may for instance be used to display the following functions:

e - the actually ordered speed function, for instance as shown continuous control between a minimum speed and a maximum speed. The instru-

ment menu is in that respect then implemented so that the displayed speed information is the rotational speed of the drill by selecting the coupling member simultaneously displayed in field h.

5

f,g - The content of water and air in the coolant used during the operation of the instrument, in the illustrated example displayed as a percentage of the maximum possible amount of spray water and spray air.

10

The four fields i, k, l and m in the lowest row on display 15 are used during the instrument menu to display the four individual working programs to be selectable during the actual menu, in the illustrated example the working program "CLEAN" displayed in the hatched field. The selection of these programs may be effected either by means of the selection switches of the display or by using the particular control member 8 on the foot contact and by the selection of a specific program this will be displayed in the actual field, e.g. by inverse display of the heading of the program.

15

As explained above it might be necessary for certain instruments, such as an instrument with an electric micro-motor, due to the restriction of the instrument menu to a limited number of working programs, to work with several parallel instrument menus between which shifting may be effected by use of the shift function in field d.

25

By use of the adjustment function in field b during the instrument menu a level shift is effected to the adjustment menu at the underlying level III associated with the actual instrument menu. An example of the implementation of such an adjustment menu is illustrated in Fig. 6.

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In comparison with the instrument menu only the display in field b in the uppermost row of fields on

display 15 has been changed, the adjustment function having been shifted to a programming function named "P". This makes it possible after an adjustment of the operational parameters to store this function "P" as part of the actual working program for future use.

In the two middle rows of fields e to m information is displayed concerning the adjustable parameters. In the illustrated example, the fields e and i occurring in the same column display maximum speed and minimum speed, respectively, and the speed control function is displayed therebeneath in field n, actually shown by a graphic symbol as a continuous control.

In the following column the overlying fields f, k display a symbol for spray water and the actually adjusted amount of spray water, respectively, and the fields g, l lying above each other in the next column display a symbol for spray air and the actually adjusted amount of spray air.

The adjustment of the operational parameters is effected by activating the fields o, p in the lowest row, allowing control in the downwards and upwards direction, respectively. The last field r in the lowest row displays the actually selected working program for which an adjustment is effected.

Thus, with this implementation of the adjustment menu firstly the field of the operational parameter, e.g. maximum speed or minimum speed desired to be changed, is operated, following which the shift is effected by controlling one of the fields o or p.

Change of the adjusted speed control function is effected by direct operation of field n, thereby for instance allowing to select cyclically between various types of speed control, e.g. continuous control, a permanent speed or two permanent speeds.

In view of the fact that for a given working program there might be a need, as explained above, for

adjusting various operational parameters of a determined working program, a number of parallel adjustment menus at level III may be associated with a certain instrument menu.

- 5 Once an adjustment has been made by means of an adjustment menu III, it is possible to shift back to the actual instrument menu by activating the level shift function in field a.

- 10 In the illustrated example of implementation it is further possible at any time to effect level shift from a selected instrument menu to the main menu, thereby allowing activation of certain auxiliary functions also when an instrument is removed for use.

P A T E N T C L A I M S

1. A dental apparatus comprising an instrument arrangement having a number of carriers for dynamic dental instruments (1), energizing units associated therewith, a detector device (3) responsive to the removal of an instrument from its carrier, an instrument operator device including a foot contact (7) with a movable control member for activating and controlling a selected instrument and for the control of auxiliary functions in conjunction with the operation thereof, and a microprocessor (4) for monitoring and controlling the operational functions of the instruments and their auxiliary functions, characterized in that a monitoring and control display (15) is associated with the microprocessor and includes a number of function display fields for visually displaying operational functions of the instrument and auxiliary functions, partial functions or functional sequences and selection switches selectively associated with the functions display fields for the selection of functions displayed in the fields, whereby the total number of selectable functions, partial functions and functional sequences is arranged in logically composed sets of function, each comprising a number of functions, partial functions or functional sequences dependent on the number of display fields, and in that the microprocessor (4) on selective activation is adapted to switch between said sets of functions.

2. A dental apparatus as claimed in claim 1, characterized in that the function display fields (213 to 216) are positioned in alignment along at least one row and/or column on the display and in that the selection switches (217 to 220) are touch-free switches activated by placing a finger in an activation zone opposite the associated function display field.

3. A dental apparatus as claimed in claim 1 or 2, characterized in that the monitoring and control

display (15) includes at least one separate information displaying field (210 to 212) to display information about the functions displayed in the function display fields.

5 4. A dental apparatus as claimed in claim 3, characterized in that an alfa-numeric keyboard is connected to the microprocessor (4) and that at least one information displaying field (210 to 212) is adapted to display information keyed by means of the keyboard.

10 5. A dental apparatus as claimed in claim 3 or 4, characterized in that the monitoring and control display (15) is a image screen with associated control devices adapted to display text and video information, said screen including the function display fields in a
15 predetermined area.

 6. A dental apparatus as claimed in any of the preceding claims in which a mode switch (10) controlled by the microprocessor (4) in dependence on information from the instrument selector device in a first mode of
20 operation, in which all instruments occupy their home position in the instrument carrier (1), is adapted to communicate with the foot contact (17) for activating auxiliary functions not associated with the instrument operation, characterized in that the microprocessor (4)
25 is adapted to display, in said first mode of operation, auxiliary functions not associated with the instrument operation in the function display fields of the display (15) and on the selection of one of said functions by means of the function selection switch, to switch on
30 the foot contact (7) to actuate an activation device for the actual auxiliary function, whereas in a second mode of operation, in which an instrument is selected for use, the microprocessor is adapted to display operational parameters of said instrument.

35 7. A dental apparatus as claimed in any of the preceding claims, characterized in that the function

display fields and the selection switches selectively communicating with the fields are organized in a matrix arrangement, that instrument operation and programming functions are organized in a hierarchically structured menu system which, for each set of operating functions displayed on the display, comprises an instrument menu (102, 103, 104) located at a first (II) level and which is displayed on the monitoring and control display by selecting the actual instrument, thereby displaying in the function display fields of the display actually adjusted operational parameters of the operation of said instrument and/or of auxiliary functions associated with the instrument, and at least one adjustment menu (105 and 109) associated with the instrument menu and located at a sub-ordinate level (III), and in that on the display of the instrument menu as well as the adjustment menu on the display in one of its fields (a) a level shift function is displayed, for switching over the display to show an adjustment menu and switching back to display the instrument menu, respectively, by operating the selection switch communicating with the field.

8. A dental apparatus as claimed in claim 7, characterized in that a number of co-ordinated instrument menus (102, 103, 104) is provided for at least one instrument, each comprising a specific number of operational functions and/or auxiliary functions, and that on displaying an instrument menu on the display a menu shift function is displayed in one of its fields (d) for shifting to a parallel menu.

9. A dental apparatus as claimed in claim 7 or 8, characterized in that for at least one instrument menu (102, 103, 104) a number of parallel adjustment menus (105 to 109) is provided at the underlying level (III), and in that on the display of each adjustment menu on the display a menu shift function for shifting

to a parallel adjustment menu is shown in one of the display fields.

10. A dental apparatus as claimed in claim 7, 8 or 9, characterized in that on the display of each instrument menu (102, 103, 104) identification information for optional selection of a corresponding number of different operation programs is shown in a number of the display fields (i, k, l, m).

11. A dental apparatus as claimed in claims 9 and 10, characterized in that on the display of an adjustment menu associated with an instrument menu identification information about the actually selected program from the instrument menu is shown in one of the display fields (r).

12. A dental apparatus as claimed in any of claims 7 to 11, characterized in that on the display of an associated instrument menu for at least one instrument, information about an actually adjusted velocity function and for motors the coupling member appropriate for the selected function as well as information about the composition of a coolant applied during the use of the instrument is displayed in a number of the fields (e, f, g, h) of the display.

13. A dental apparatus as claimed in any of claims 7 to 11, characterized in that the instrument-carriers are associated with instrument suspension devices (2) for optional connection of various dynamic instruments, that each suspension device includes an instrument sensor member monitored by the microprocessor (4) and adapted to sense the type of the actually connected instrument, and in that one or more energizing source(s) (14) is/are connected to a control circuit (13) controlled by the microprocessor (4), which selects said source(s) for an energy generating function appropriate for the selected instrument or instruments.

14. A dental apparatus as claimed in claim 13, characterized in that on the display of each instrument menu on the display, identification information about the instrument operational parameters is shown in one
5 of the display fields (h).

15. A dental apparatus as claimed in any of the preceding claims 7 to 11 and comprising a switch-over member controlled by the instrument detector unit (3), which with all instruments in their home position in
10 their carriers, switch over the foot contact (7) to control auxiliary functions not associated with the operation of the instrument, characterized in that the hierarchically organized menu system includes a main menu (101) positioned at an overlying level (I), on the
15 displaying of which on the display identification information about a number of auxiliary functions not associated with the operation of the instrument are shown in a number of the display fields (e to m), and in that on displaying each instrument menu on the
20 display a level shift function for shifting to the overlying level is indicated in one of the display fields (a), and on displaying the main menu a level shift function for switching back to the actual instrument menu is displayed in one of the display fields
25 (a).

16. A dental apparatus as claimed in claim 15, in which the microprocessor is further programmed for monitoring and controlling various using positions of a patient's chair, characterized in that a number of
30 adjustment functions of the chair is included in an auxiliary function menu (112) displayed at a level II sub-ordinated in relation to the main menu (101), that on displaying the main menu (102) on the display, identification information about said auxiliary function
35 menu (112) is shown in one of the display fields (m), and that on displaying the auxiliary menu (112) on the

25

display a level shift function for switching back to the main menu is displayed in one of the display fields (a).

- 5 17. A dental apparatus as claimed in claim 16, characterized in that an adjustment menu located at a further sub-ordinated level (III) for adjusting chair setting parameters is associated with the auxiliary function menu (112).

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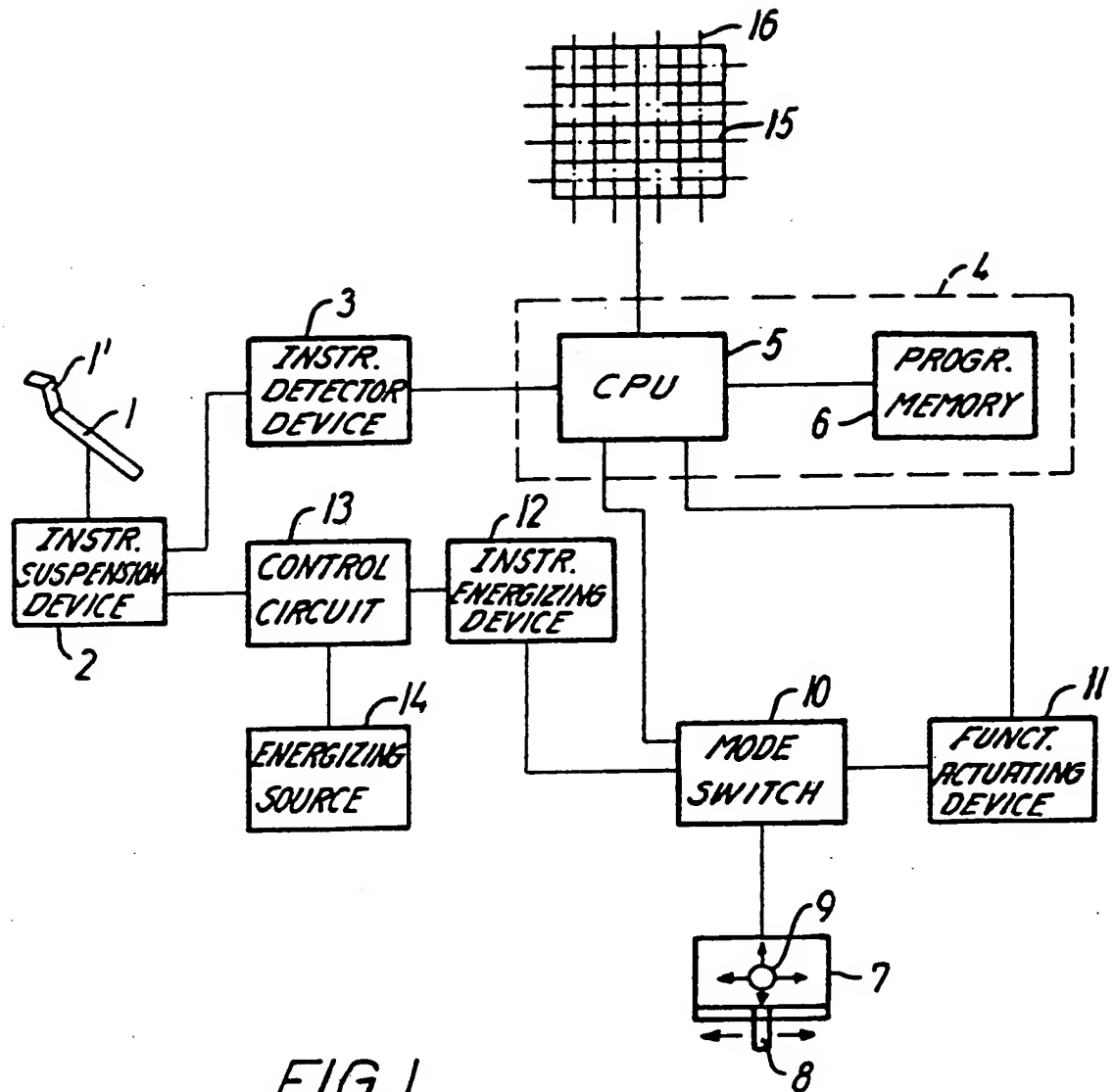


FIG. 1

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FIG. 2

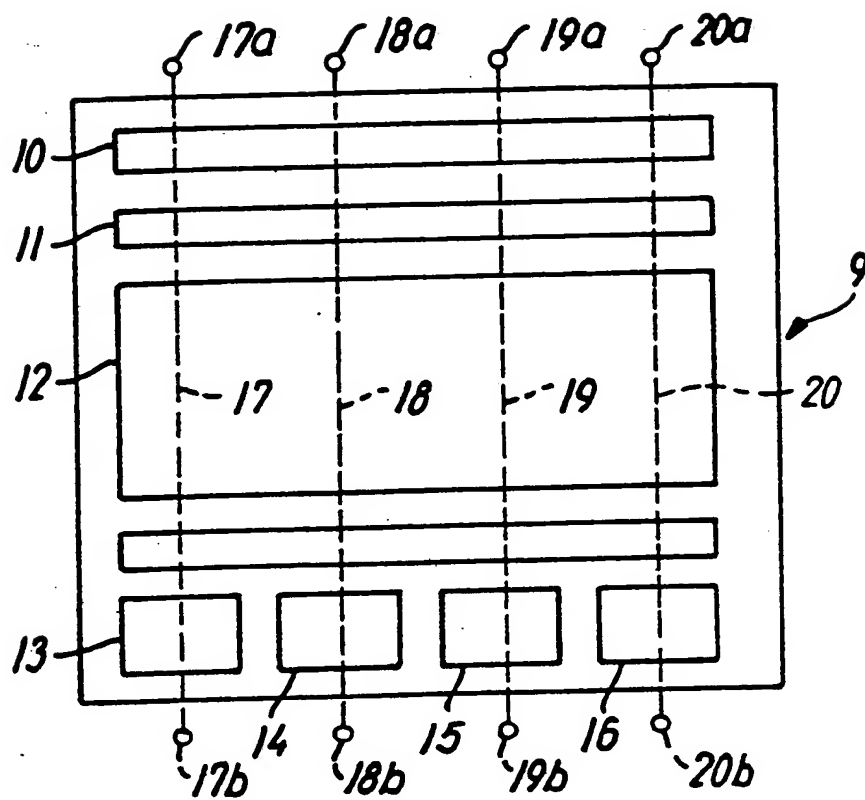
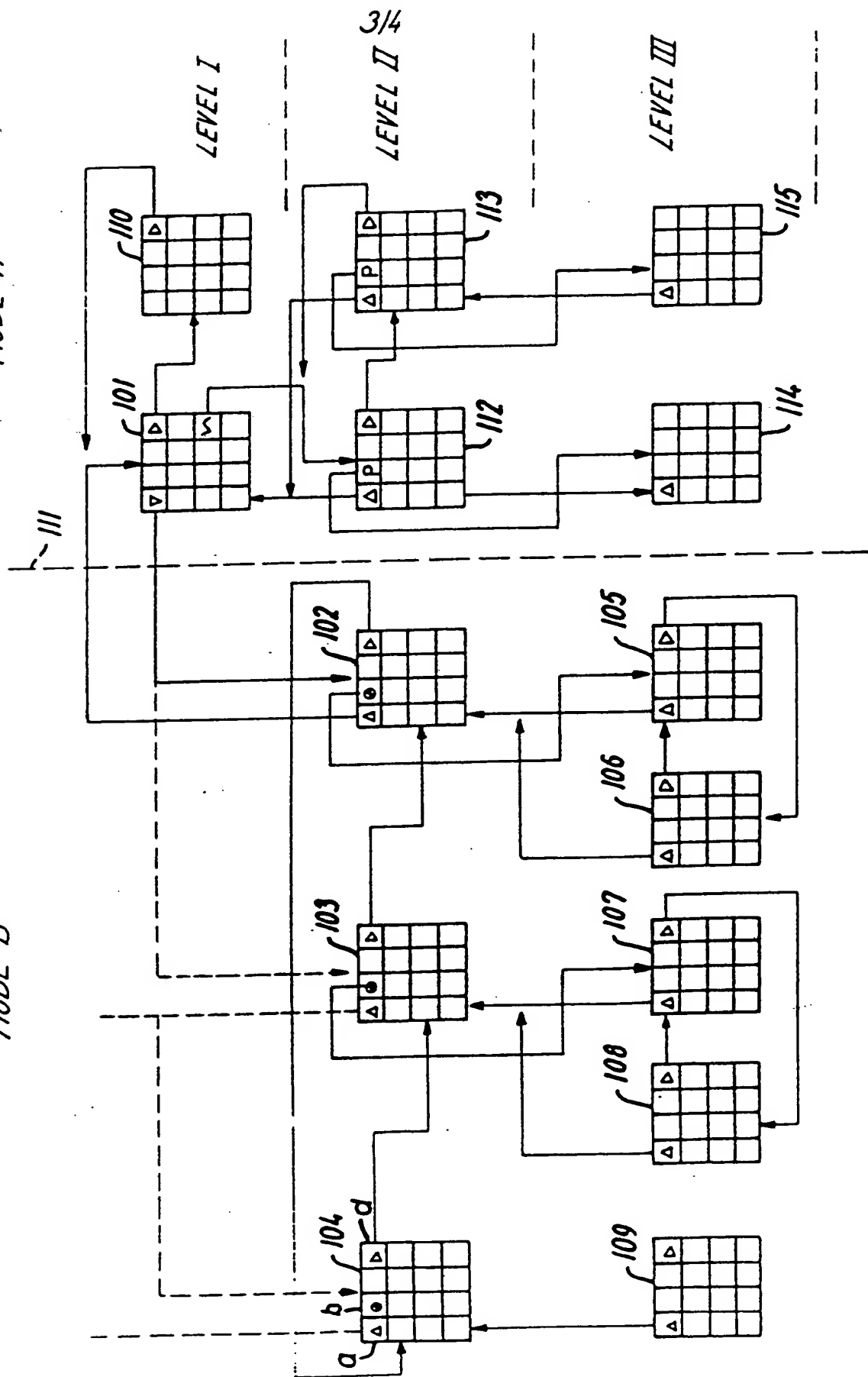


FIG. 3

MODE A

MODE B



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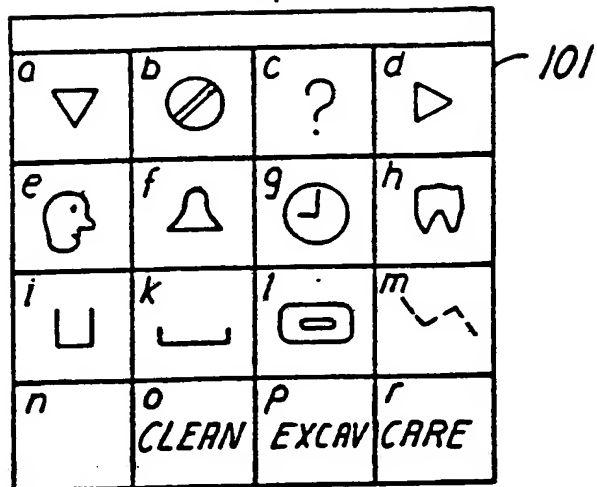


FIG. 4

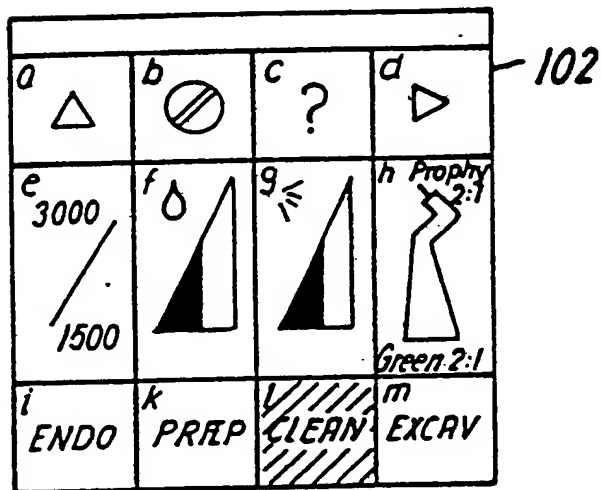


FIG. 5

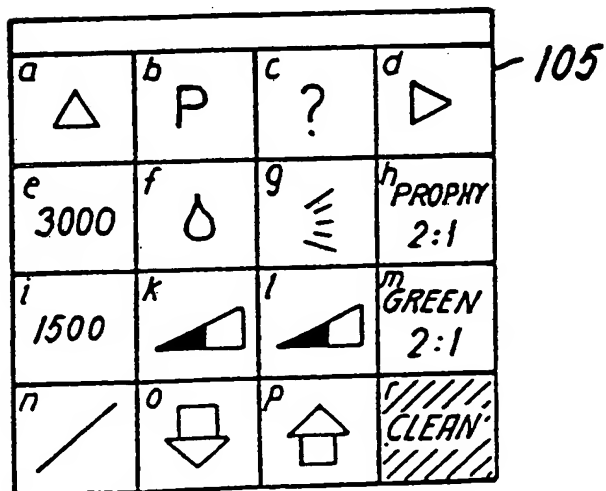


FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No PCT/DK88/00215

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) According to International Patent Classification (IPC) or to both National Classification and IPC 4 A 61 C 19/00		
II. FIELDS SEARCHED <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Minimum Documentation Searched⁷</div> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%; border-top: 1px solid black; border-bottom: 1px solid black;">Classification System</div> <div style="width: 45%; border-top: 1px solid black; border-bottom: 1px solid black;">Classification Symbols</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 45%;">IPC 4</div> <div style="width: 45%;">A 61 C</div> </div> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched⁸</div> <div style="padding: 10px 0;">SE, NO, DK, FI classes as above</div>		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰ :	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No ¹³
A	EP, A1, 42 267 (A/S FLEX DENTAL) 23 December 1981	1 - 17
A	EP, A1, 42 268 (A/S FLEX DENTAL) 23 December 1981	1 - 17
A	EP, A1, 42 269 (A/S FELIX DENTAL) 23 December 1981	1 - 17
:		:
:		:
:		:
:		:
:		:
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>¹⁰ Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"G" document member of the same patent family</p> </div> </div>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search 1989-03-22	Date of Mailing of this International Search Report 1989-03-31	
International Searching Authority Swedish Patent Office	Signature of Authorized Officer Jack Hedlund	